Control and elimination strategies for schistosomiasis in Burkina Faso, West Africa

The effect of five years of mass drug administration on prevalence and intensity of infection

Student thesis

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ABSTRACT

Background and objectives. Between 2004 and 2013, five rounds of mass drug administration (MDA) of praziquantel has been rolled out in the control of schistosomiasis in Burkina Faso, West Africa. The aim of this study is to analyse the effect of MDA of praziquantel on the prevalence and intensity of infection of schistosomiasis in Burkina.

Methods. A longitudinal survey was conducted from 2004 to 2008 at 22 sentinel sites across Burkina in order to estimate the presence of *Schistosoma haematobium* infection. In addition, in 2013, a cross sectional remapping study of school children aged 7 to 11 years was conducted at the same sites. Standardised diagnostic techniques were used to analyse stool (Kato Katz) and urine (filtration) samples from every participant for the presence and number of *S. mansoni* and *S. haematobium* eggs.

Results. The findings from the longitudinal survey show a reduction in the median prevalence of *S. haematobium* from 16% to 3%. The cross-sectional survey show that 13 of 22 sentinel sites still had a prevalence of schistosomiasis >1%, with a prevalence of 56% at the highest. The prevalence of schistosomiasis was higher among boys and the older children.

Conclusions. MDA of praziquantel may reduce the prevalence of schistosomiasis; however, the control strategies must be implemented in a comprehensive way in order to eliminate this neglected tropical disease in Burkina Faso. In line with the World Health Organization (WHO) guidelines, increased frequency of drug distributions, alongside health education and improvement of sanitation and access to improved water sources, is needed. Further and more detailed research on the effect of MDA is needed in order to determine the effect of control strategies and future priorities for the control of schistosomiasis in Burkina Faso.

INTRODUCTION

Neglected tropical diseases

Neglected tropical diseases (NTDs) are a group of infectious diseases that cause debilitating suffering among millions of the poorest people in the world (1). NTDs typically thrive in resource-limited societies in tropical climates, and have for a long time been more or less absent from the international public health agenda. The term "NTDs" was developed as a reaction to the understatement of these diseases in the United Nations' Millenium Development Goal number six; "combat HIV/AIDS, malaria and other diseases" as well as the establishment of the Global Fund to fight AIDS, tuberculosis and malaria. Pioneer scientists showed in a series of publications how these *other diseases* for many years have been overshadowed by the battle against the "three big" HIV/AIDS, malaria and tuberculosis (2-4). Gradually, NTDs have become a priority on the global health agenda, and the battle against these diseases has gained momentum and resources (5, 6).

In the mid 2000s, the fight against NTDs saw a paradigm shift as the World Health Organization (WHO) moved away from the traditional disease-centered approach to a specific response strategy to the broad health needs of low- and middle-income countries. In 2005, this resulted in the establishment of the WHO Department of Control of Neglected Tropical Diseases (6). Several global initiatives followed that aimed to increase the attention and awareness of NTDs, including the Global Network for Neglected Tropical Diseases and The Task Force for Global Health. Together, these efforts have culminated in the development of elimination programmes such as the Global Programme to Eliminate Lymphatic Filiariasis (GPELF) and the African Programme for Onchocerciasis Control (APOC) (7-11). In 2007, in order to advance the growing scientific literature on NTDs, the Public Library of Science (PLoS) launched PLoS Neglected Tropical Diseases; an open-

access and non-profit journal funded by the Bill & Melinda Gates foundation (12).

WHO have identified 17 neglected tropical diseases (Table 1), of which two are targeted for eradication[a]; dracunculiasis and yaws, and four are targeted for elimination[b]; trachoma, human African trypanosomiasis, leprosy and lymphatic filariasis (6). Moreover, WHO have identified some states as target countries for elimination of schistosomiasis (13).

Table 1. The etiology, epidemiology and main control strategies of the most prevalent neglected tropical diseases (WHO 2013).

Disease	Agent	Number of infected	Number at-risk	Main control strategy
Soil-transmitted helminths	Helminth	2 billion	>2 billion	MDA
Schistosomiasis (bilharziasis)	Helminth	250 million	779 million	MDA
Trachoma	Bacteria	150 million	229 million	SAFE strategy
Dengue	Virus	50-100 million	>2.5 billion	Vector control (mosquitos)
Food-borne trematode infections	Helminth	56 million infected	Not known	MDA
Cysticercosis	Helminth	>30 million; >10 million with neurocysticercosis	Not known	MDA, human and veterinary prevention
Onchocerciasis	Helminth	25 million	125 million	MDA
Lymphatic filariasis	Helminth	20 million	1.4 billion	MDA

MDA: mass drug administration; SAFE: Surgery (S), antibiotics (A), facial cleanliness (F) and environmental change (E).

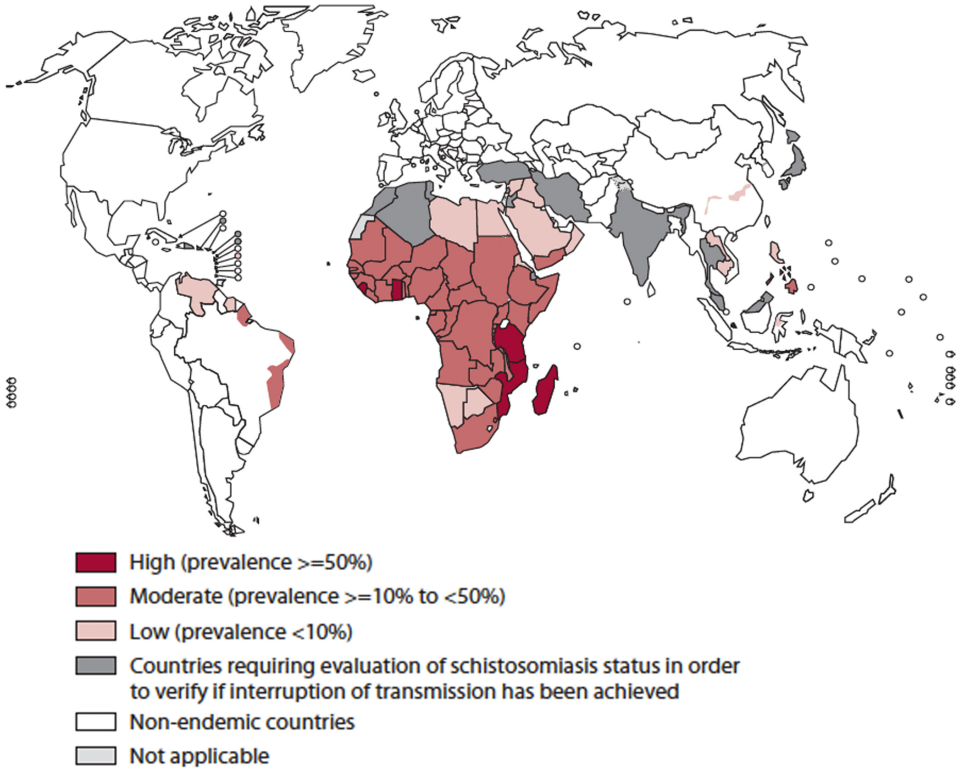
[a] A permanent reduction to zero of the worldwide prevalence of an infectious disease; continued measures are no longer required.
[b] A reduction to zero of the number of new cases of an infectious disease in a defined geographic area; continued intervention or surveillance measures are required.

Schistosomiasis

Schistosomiasis is a common cause of acute and chronic disease, especially in sub-Saharan Africa (18). Over 200 million people are estimated to be infected worldwide, of whom only half are symptomatic. Approximately 20 million are estimated to have severe complications of the disease (14), and among the infected, around half are estimated to be school-age children (typically 5-14 years of age) (19).

Mainly five species of schistosomes are pathogenic to humans: *Schistosoma haematobium* that causes urogenital schistomiasis, and *S. japonicum*, *S. intercalatum*, *S. mansoni* and *S. mekongi* that cause intestinal schistomiasis (20). *S. haematobium* and *S. mansoni* are prevalent mainly in sub-Saharan Africa and along the Nile, whereas *S. japonicum* and *S. mekongi* are endemic in East Asia. *S. intercalatum* is mainly prevalent in focal areas of equatorial Africa (Figure 1) (21).

Figure 1. The geographical distribution of schistosomiasis (WHO, 2010).

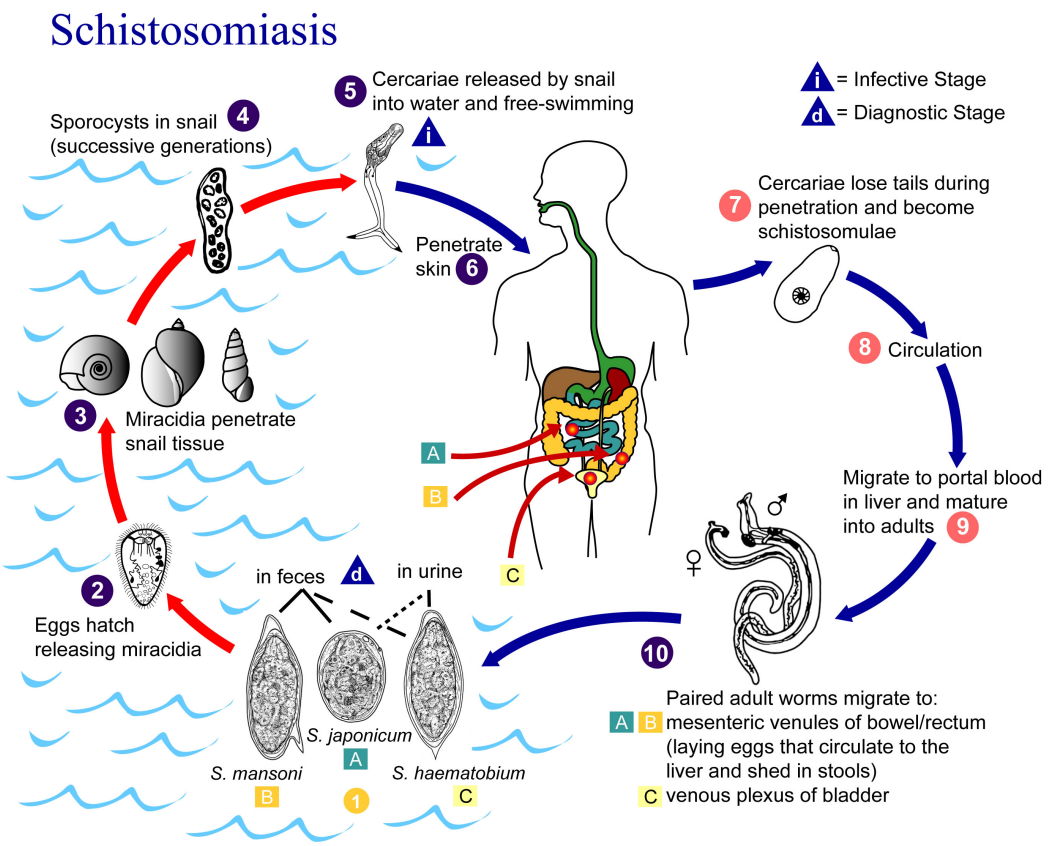


The life cycle of schistosomes

Schistosomes are a group of trematode, parasitic worms, or helminths, with a two-stage life cycle (Figure 2) (21-23). Humans get infected through contact with freshwater containing infectious larvae named cercariae. The larvae penetrate intact skin, and develop into immature worms (schistosomulae). The schistosomulae get carried with the lymph and blood to the right side of the heart, and subsequently to the lungs, where they migrate across the pulmonary capillaries to the left side of the heart. They are thereafter carried with the arterial blood flow to the portal vein of the liver where they mature into adult worms. This process may take up to eight weeks. A pair of mature female and male worms then make their way from the liver, against the venous blood stream, to perivesical (*S. haematobium*) or mesenterical (*S. mansoni* and other species) venous plexuses.

Within these small venules, the female worm can lay up to several hundreds of eggs a day for up to several decades (24, 25). The eggs penetrate the vessel wall and migrate into the organ tissue (21-23). The eggs that reach the lumen of either the bladder (*S. haematobium*) or the colon (*S. mansoni*), are excreted in the urine and stool, respectively, whereas the remaining eggs get trapped in the tissue, causing inflammation and organ damage. Excreted eggs hatch when they reach fresh water and miracidia (immature larvae) are released from within the eggs, actively seek out and penetrate fresh water snails (intermediate hosts). The miracidia multiply asexually within the snail, a process that may take from four to six weeks, before they end up as cercarial larvae. Cercariae finally leave the snail in search of a definitive human host, thereby completing the cycle (Figure 2).

Figure 2. The schistosome life cycle (Centers for Disease Control (CDC) 2012).



Clinicopathological presentation

The main burden of the schistosomal disease is caused by chronic inflammation due to the schistosome eggs that remain in the tissue. Chronic schistosomiasis occurs most commonly in endemic areas, where individuals get continuously exposed and re-exposed to schistosomes over many years, often already from early childhood (26).

Most people infected with schistosomes show no or few symptoms, and many may have non-specific symptoms such as fatigue, impaired cognitive development and reduced work capacity. However, severe disease develops in heavily infected individuals, and probably depends in part on factors such as the schistosome genetics and the human immunogenetic profile (21-23).

Acute infection may present shortly after skin penetration as cercarial dermatitis, and after a few weeks to months as Katayama fever (27, 28). Both forms are most common in travellers, although infection with *S. japonicum* commonly presents acutely also in people living in endemic areas. The acute forms of schistosomiasis are thought to represent allergic reactions to the various stages of the parasite (28). In some cases, disease may be caused by eggs dislodging from the most common parasite locations in the body, to so-called ectopic foci such as the lungs and central nervous system (29).

Diagnosis

The diagnosis of schistosomiasis is traditionally made by microscopic detection and quantification of eggs in urine (*S. haematobium*) or faeces (*S. mansoni* and *S. japonicum*). Specific concentration methods, Kato-Katz for stool (64) and filtration of urine (65, 66), are used in order to increase the probability of detecting any present eggs. In field settings, WHO suggest to use urine dipsticks to detect haematuria in high-endemic areas.

Serological assays of circulating antibodies to schistosomal antigens has been used to aid diagnosis in travellers; however, these tests have until now been of little use in high-endemic settings as this method does not distinguish between prior and ongoing infection (67). Recently, a point-of-care circulating cathodic antigen (CCA) assay has been developed to detect both *S. mansoni* antigens in urine (68). In fact, studies indicate that this test may prove more sensitive than the Kato-Katz method for diagnosing schistosomiasis in endemic settings, and allows for testing without the collection of stool samples (69, 70). Eggs or worms may also be detected by examining tissue biopsies (63, 71), and DNA may be detected in serum, faeces or urine, although the use of the latter tests is limited by the relatively high

costs and irregularities in egg excretion (72-74). Ultrasound, PET-scans and other radiographic methods may be used to reveal organ damage (75).

Treatment and control strategies

Praziquantel is the drug of choice for treatment of schistosomiasis and the number of tablets may be easily calculated according to a tablet-pole, which visualises a dose corresponding to at least 40 mg/kg based on the individual's height. Advocacy efforts have led to a reduction in the price of praziquantel in most countries, and large quantities of tablets are now being donated by pharmaceutical companies (66, 67).

WHO promotes five main public health interventions in the battle against schistosomiasis: preventive chemotherapy, vector control, access to safe drinking-water, basic sanitation, hygiene services and health education (6). WHO has proposed a plan for the control and elimination of schistosomiasis, and states that elimination may be possible through the main control interventions and improved coordination of stakeholders (5). Of the above-mentioned interventions, preventive chemotherapy with praziquantel has been selected as the most important tool due to its cost-effectiveness, safety and rapid impact (18). Snail control, on the other hand, is considered less cost-effective and can be harmful to the environment (20).

Recently, unprecedented drug donations of praziquantel, as well as the proven successes of mass treatment programmes, such as those initiated by the Schistosomiasis Control Initiative, have reinforced WHO policies (13, 67, 76). Mass drug administration (MDA) consists of distributing drugs to the entire population in endemic areas, regardless of individual diagnosis. Drug administration can be implemented community-wide through for example community health workers that go from house-to-house, or through campaigns in specific

population groups, such as school-age children at primary schools. WHO recommends treatment frequency based on the prevalence of schistosomiasis, determined by country mapping or by sentinel sites[c] (66) (Table 2).

Table 2. Preventive chemotherapy strategies for the control of schistosomiasis (WHO 2011).

Category	Prevalence school-age children	Recommended strategy	
High risk community	≥50% by parasitological methods (intestinal and urogenital schistosomiasis) or ≥30% by questionnaire for visible haematuria (urogenital schistosomiasis)	Treat all school-age children (enrolled and not enrolled) once a year	Also treat adults at risk from special groups to entire communities in endemic areas)
Moderate-risk community	≥10% but <50% parasitological methods (intestinal and urogenital schistosomiasis) or <30% by questionnaire for visible haematuria (urogenital schistosomiasis)	Treat all school-age children (enrolled and not enrolled) once every 2 years	Also treat adults considered to be at risk (special risk groups only)
Low-risk community	<10% by parasitological methods (intestinal and urogenital schistosomiasis)	Treat all school-age children (enrolled and not enrolled) twice during their primary schooling age	Praziquantel should be available in dispensaries and clinics for treatment of suspected cases

The national NTD control programme of Burkina

The Schistosomiasis Control Initiative (SCI) was established in 2002 with funding from the Bill & Melinda Gates Foundation (BMGF) and is based at Imperial College in London. SCI selected Burkina as one of the first countries to prove the concept of feasible nationwide MDA against schistosomiasis (7). The control strategies were to be implemented through the national Ministry of health, and the target was set out to treat at least 75% of school-age

[c] *Sentinel sites*: randomly selected primary schools in schistosomiasis-endemic areas in which school children are followed prior to each treatment round

children and other populations at risk. The MDA would include both praziquantel against schistosomiasis and benzimidazoles against soil-transmitted helminthes (STH); an integrated approach supported by the evidence of co-endemicity of these diseases. Continuous monitoring and evaluation were essential in order to track programme targets (8).

Study objective

The aim of this study is to analyse the effect of five years of MDA of praziquantel on the prevalence and intensity of infection of schistosomiasis in Burkina Faso.

METHODOLOGY

Burkina Faso

Burkina Faso is a landlocked country in West Africa with a population of close to 16 million people (Figure 3). The majority of the population lives in the south and central parts of the country, including the capital city, Ouagadougou. Up to 80 % of the population works in the agricultural section (1) . The country is currently rated 183 of 187 countries in the world on the Human Development Index (HDI), and the poverty rate is estimated to be 66 % of the population (2). Primary education is free, but not compulsory. In 2013, the national primary school enrolment rate was 81%; however, there are large regional and gender-based variations, with some areas showing primary school enrolment rates of girls as low as 40 %.

Figure 3. Burkina Faso is a land-locked country situated in West Africa.

Youth illiteracy rates are currently estimated to be 28%, compared to about 70% on average for sub-Saharan Africa (3). The country has a three level health system; a central Ministry of health, 13 regional health departments and 63 health districts (4). Approximately 6 % of the gross domestic product is spent on health care, and there are less than one health care professional per 1,000 inhabitants (5).

Burkina, a prior French colony, has gone through several governmental changes since it gained its independency in 1960. The population is made up of a number of tribes, of which the Mossi are the most common. The country consists of two main ecological zones: a sandstone massif in the southwest and peneplain[d] in the rest of the country. Several major rivers flow through the country; however, only the Black Volta and the Komoé are perennial. Average temperatures are in general highest in the north, with a progressively milder climate towards the south (6).

Pre- and post-MDA surveys

Pre-treatment mapping data prior to 2004 suggest that all 63 health districts were endemic[e] for schistosomiasis. From 2004 to 2012, independent of the respective district-level prevalence, the country chose to roll out five biennial MDA of praziquantel to school age children in all districts (9). School attendance rates proved to be less than 50%, and measures were taken to reach non-enrolled school-age children. The first round of MDA was financed by BMGF, while the second round of treatment, which took place between 2006 and 2008 and targeted more than 2.5 million school-age children in nine districts, was supported by SCI and the United States Agency for International Development (USAID). In September

[d] *Peneplain:* a gently undulating, almost featureless plain, believed to be the final stage of the geomorphic cycle of landform evolution.
[e] *Endemic*: The constant presence of diseases or infectious agents within a given geographic area or population group (CDC).

2010, USAID awarded FHI 360 two five-year term agreements to administer the End Neglected Tropical Diseases (END) in Africa and END in Asia programmes (10).

In order to evaluate the impact of treatment on population health and the prevalence of schistosomiasis and soil-transmitted helminths, cohorts of school-age children in sentinel schools were examined before each treatment round (11). The results have allowed the country to evaluate and, if necessary, adjust their control strategies according to guidelines (12). The most recent survey was conducted in 2013, with financial and technical support provided by USAID, Helen Keller International, FHI 360 and END in Africa (13).

Data collection and analysis

During six weeks of January and February 2014, the authors studied the methodology and in-country conditions for the most recent sentinel site survey conducted in Burkina. Information and data were gathered through meetings with national NTD staff within the Ministry of health, including the national NTD coordinator in Ouagadougou, studies of internal and official survey documents and reports, and meetings with laboratory staff that had contributed to the survey. Survey results and challenges were discussed and analysed throughout these meetings.

Sentinel site survey methodology

A longitudinal cohort study of primary school sentinel sites selected from 11 of the 13 regions of Burkina was conducted from February to June 2013. Two sentinel sites were selected in each of the 11 regions, except for the region of Hauts-Bassins, which has three sentinel sites, and Cascades, which has only one. In addition to the 2013 study, annual

surveys have been conducted since 2008, apart from in 2011 from when no data is available due to limited resources, and in 2012, when only a minority of the sentinel sites was studied.

Thirty-two school children from each age group between 7 and 11 years were selected to participate in the study, in total 160 pupils from each sentinel site. The sample sizes were calculated using an average intensity of *S. haematobium* infection and expected reduction predicted by the software EpiSchisto (14). A research team from the national NTD programme, equipped with a mobile laboratory, collected and analysed samples from each of the selected sites. When roads were in good enough condition, the team would drive the mobile laboratory to the sentinel school and samples were examined on site. When road conditions were poor, due to rain and other weather constraints, the team would set up the laboratory in a nearby village where samples would be analysed after being collected at the respective sentinel site. All samples were examined the same day they were collected, regardless of the laboratory's location.

The 32 children from each age group were selected by dividing the total number of children in each age group present at the school by 32; e.g. if 320 children were present in one age group, every tenth child would be selected. One of the laboratory technicians would randomly select which of the first three children they were to start counting from, and every child selected at the given interval would be asked to provide a sample. The selected children were given two pots, one for stool and another for urine, and were instructed on how to collect the samples. The samples were collected between noon and 2 pm. This routine continued until all the samples from each school were collected and analysed.

The Kato-Katz technique was used to detect *S. mansoni* eggs in the stool samples, and

intensity of infection was estimated by calculating the number of schistosome eggs per gram of feces. For *S. haematoubium*, the urine was evaluated for haematuria using dipsticks, and thereafter examined for schistosome eggs by filtering 10 mL of urine per child. Two trained laboratory technicians examined every sample once.

Ethical considerations

The study was granted approval by the National Ethics Committee in Burkina, and for every school that was selected, consent was obtained from the principal on behalf of the children. This study did not pose any harm or risk to the participants, and all school-age children were offered treatment with praziquantel in the following MDA.

Statistical analysis

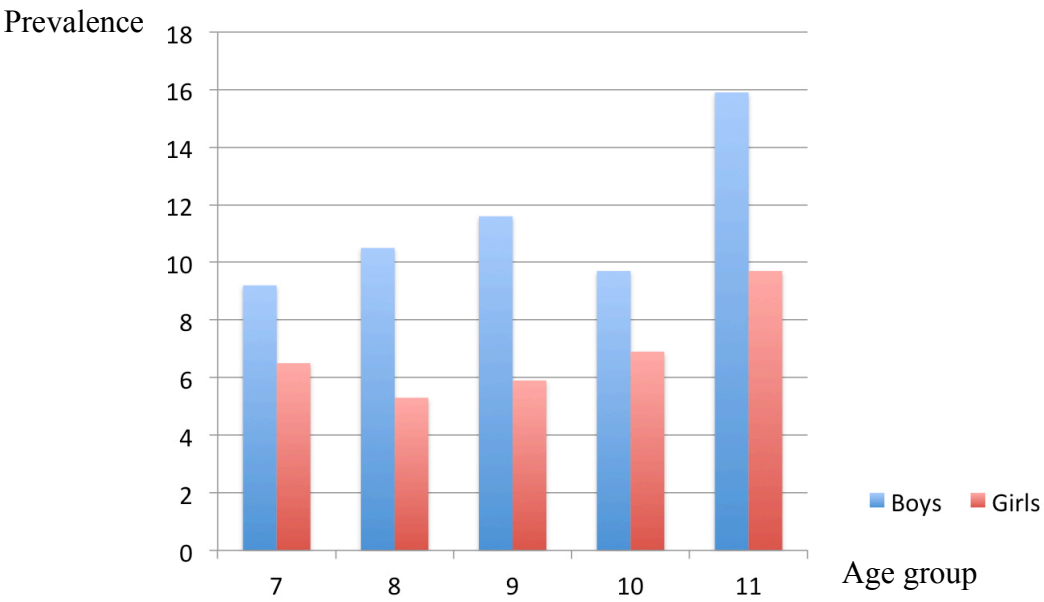
All data was plotted into Excel before analysed using SPSS v.17 for statistical analysis. Descriptive statistics and results of some comparative analyses were presented. The authors could unfortunately not access the original data set were therefore not able to perform further analysis at the time of this study.

RESULTS

Prevalence of schistosomiasis in Burkina Faso, 2013

In total, 3,520 school-age children between 7 and 11 years old provided samples for the survey. The number of children per age group ranged from 699 among 10 year olds to 709 among 9 year olds. Fifty per cent of the total population were girls. Figure 4 shows the prevalence of schistosomiasis based on the sexes being equally distributed among the age groups. The overall prevalence of schistosomiasis in boys and girls in sentinel sites was 9,2%, and the prevalence among girsl was significantly lower (p <0.05) than among boys.

Figure 4. Prevalence of schistosomiasis (*S. haematobium* and *S. mansoni*) according to gender and age in Burkina Faso, sentinel site survey 2013.



Intensity of infection

Figure 5 shows the distribution of intensity of infection according to gender. Boys had heavier intensity of infection then their female counterparts, and in total, 11 year olds had

heavier infections than other age groups. Ninety-one per cent of 11 year olds with a positive sample had a moderate or heavy intensity infection.

Figure 5. Intensity of schistosome infection according to gender in Burkina Faso, sentinel site survey 2013.

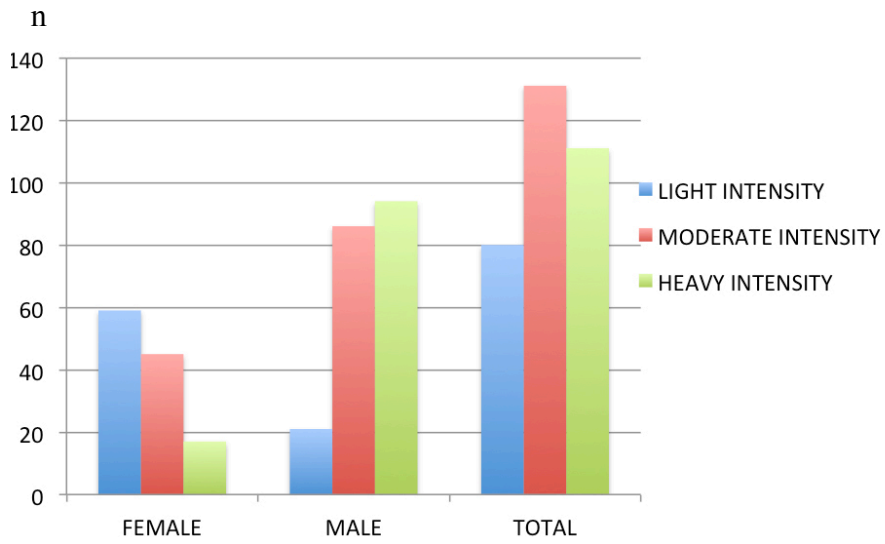
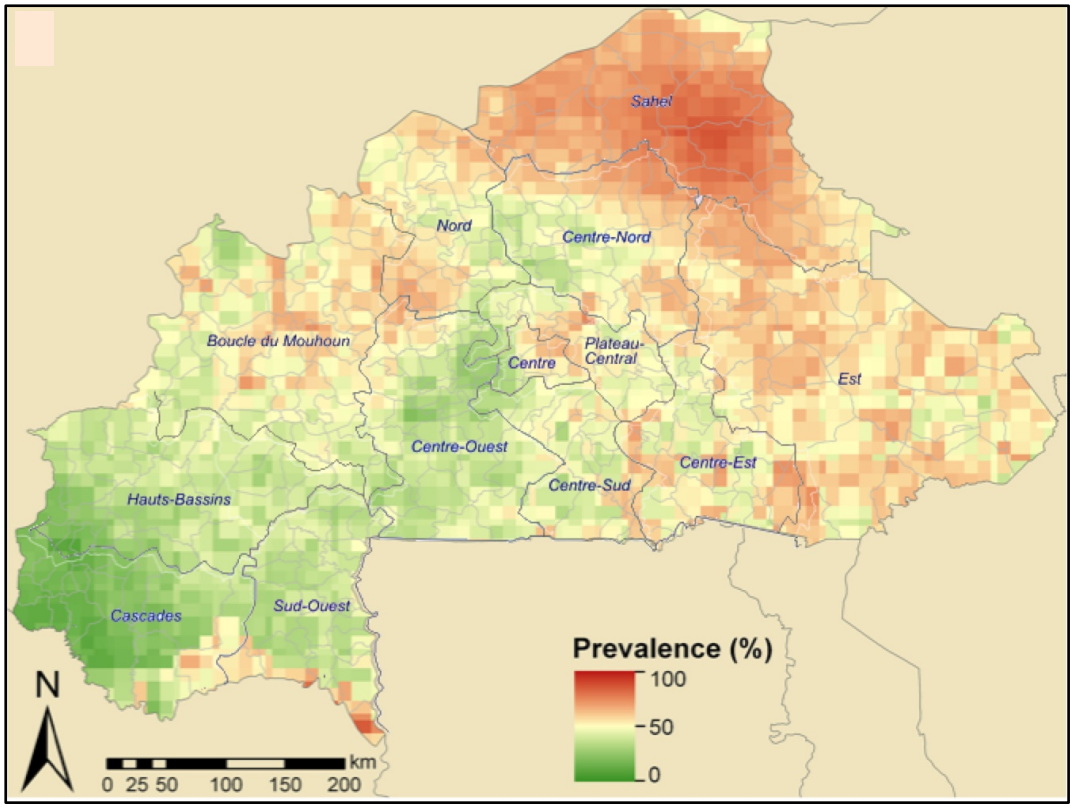


Figure 6 summarises the results from the cross-sectional survey of schistosomiasis in Burkina Faso in 2013. The prevalence map shows that areas with high prevalence are found especially in the northern and eastern parts of the country, whereas central and southern areas have a lower prevalence. The prevalence of schistosomiasis in the region of Sahel in Burkina is 21%, making it the region with the highest prevalence in the country.

Figure 6. The estimated prevalence of schistosomiasis in Burkina Faso, 2013 (15).



Longitudinal prevalence from 2008 to 2013

Table 3 shows the prevalence of *S. haematobium* infection from 2008 until the most recent sentinel site survey results from 2013. From 2008 to 2013, a significant reduction ($p < 0.05$) was observed in the prevalence of *S. haematobium* infection among the examined school-age children in sentinel sites. Two of the sentinel sites experienced an increase in prevalence, most markedly in Lioulgou in the Centre East region.

Table 3. The prevalence of *S. haematobium* infection from 2008 to 2013, longitudinal sentinel site surveys in Burkina Faso.

REGION	SENTINEL SITE	Prevalence of *S. haematobium* (%)				Reduction in %
		2008	2009	2010	2013	2008-2013
Boucle du Mouhoun	Tikan	14.4	5.6	3.0	12.5	13.2
	Tiao	0.0	0.0	0.0	0.0	0.0
Centre Est	Nianle	15.0	10.3	3.1	12.5	16.7
	Lioulgou	14.4	22.0	21.8	56.3	-290.6
Centre Nord	Sidogo	10.0	0.0	0.0	5.6	43.8
	Tougouri	16.3	2.2	20.4	5.0	69.3
Centre Ouest	Soala	16.9	1.3	0.6	0.0	100.0
	Bayandi Palogo	23.1	0.0	8.2	0.0	100.0
Centre Sud	Badongo	29.4	0.0	3.5	2.5	91.5
	Mediga	13.8	0.7	2.9	2.5	81.9
Nord	Doure	11.3	0.0	0.0	0.0	100.0
	Koumbri	23.1	1.3	0.7	1.9	91.9
Hauts-Bassins	Kari	1.7	0.0	0.0	0.0	100.0
	Panamasso	17.9	32.3	34.5	25.0	-39.7
	Noumousso	1.3	0.5	0.4	0.0	100.0
Sahel	Windou/Lerbou	38.8	33.3	23.8	20.6	46.8
	Dori B	55.0	15.0	27.7	20.6	62.5
Sud Ouest	Gora	0.0	0.0	0.0	0.0	0.0
	Bawan	11.3	0.0	0.0	0.6	94.4
Est	Nagbingou	22.5	58.7	53.1	17.5	22.2
	Sampieri	25.0	8.9	21.5	18.8	24.7
Cascades	Douna	20.4	4.3	8.4	0.0	100.0
MEDIAN		**15.7**	**1.3**	**3.0**	**2.5**	**66.0**

DISCUSSION

Since the turn of the century, the control of NTDs has gained increased attention and global momentum, opening up for unprecedented opportunities to end the suffering caused by these highly prevalent and, still, neglected diseases. In 2004, Burkina Faso was selected as one of the first countries to prove the concept of a nationwide NTD control programme through MDA of praziquantel. The findings from the longitudinal sentinel site surveys prior to each of the five rounds of MDA suggest that the prevalence of schistosomiasis has been significantly reduced from more than 17% in 2008 to less than 10% in 2013.

The findings from the surveys in Burkina are in line with results from a number of studies of MDA of praziquantel in other African countries (21-24). A study from Mali found a 30% decrease in prevalence over six years of MDA (22), whereas two studies from Uganda found a marked decrease in both prevalence and intensity of *S. mansoni* infection (21, 23). MDA of praziquantel may lead to reduced intensity of infection, although the impact on prevalence may vary between different age groups. In this study, longitudinal data on the intensity of infections was not available, and the impact of MDA on intensity of infection could therefore not be determined.

Although the district level prevalence of schistosomiasis has been reduced, the majority of sentinel sites still show proof of schistosomiasis in the school-age population. Moreover, one school in the Centre East region saw an increase in prevalence from 14 to 56%. One possible explanation for this could be the recent increase in population size, alongside newly developed irrigation systems (18) which may increase transmission rates (19). If the results from this site are excluded, the average prevalence would be reduced from 19 to 7%.

Both the prevalence and intensity of infection of schistosomiasis were significantly higher among boys than among girls. One possible explanation might be that boys due to social norms or traditions are more often in contact with water than their female counterparts, thereby making them more exposed to cercariae. A study conducted in Mali observed that the water related activities consisted of helping parents fishing, growing vegetables and other domestic activities (20). Also, in line with previous studies, the results found a higher prevalence among 11 year olds compared with the other age groups (10).

This survey has several limitations. The methodology for selecting sentinel sites was not described, and the validity of the results may therefore not be determined. If the selected sentinel sites are located far from schistosome transmission sites, the prevalence of schistosomiasis in the district could in reality be higher than indicated. Moreover, the sample size calculation was not described in detail, and the statistical validity of the findings could therefore not be determined. The regions in Burkina are vast, and it is possible that the sentinel sites might not be representative for the overall population. Moreover, no sentinel sites have been chosen in the regions containing the two largest cities, Ouagadougou and Bobo-Dioulasso, with a joint population of 2.1 million inhabitants.

Only prevalence data are available for all survey years, and results of intensity of infection are available from 2013 only. The actual effect of biennial MDA strategy could therefore not be evaluated, as prevalence may or may not follow changes in intensity of infection. Furthermore, data from 2011 and 2012 are limited or unavailable, and the increase in prevalence observed in five of the sentinel sites could not be further evaluated. The authors were not able to gather sufficient data from other sources in order to analyse the results. Finally, the distribution of gender across age groups was not given and the impact of gender-

biased prevalences could have affected the results.

Despite five rounds of MDAs from 2004 and 2012, data suggest that schistosomiasis is still prevalent in a number of health districts in the country. In November 2013, the national NTD department at the Ministry of health in Burkina reviewed their control strategies for schistosomiasis. The Ministry concluded that the country will follow WHO guidelines, which suggest that control strategies should be implemented according to the district level prevalence of schistosomiasis (Table 2). A national elimination committee will be established in order to review the country's strategies for ultimately eliminating schistosomiasis and other NTDs as a public health problem in Burkina (9).

CONCLUSION

The impact evaluation of five years of MDA of praziquantel in Burkina Faso from 2004 to 2012 suggest that treatment has had a significant impact on reducing the prevalence of schistosomiasis. However, the prevalence of schistosomiasis still remains higher than 10% in 8 of the 22 districts with sentinel sites, and there are important variations in prevalence and intensity of infection between districts and gender. Recently, Burkina has committed to follow WHO guidelines for the control and elimination of schistosomiasis, and a national elimination commitee will review the country's strategies for ultimately eliminating schistosomiasis and other NTDs as a public health problem in Burkina Faso.

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